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Estech General Chemicals Corporation Duette Mine, Manatee County, Florida Resource Document: Soils

Zellars-Williams, Inc, Lakeland, FL

Prepared for

Environmental Protection Agency, Atlanta, GA Region IV

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345 Courtland Street, NE
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Environmental Impact Statement

DRAFT

Estech General Chemicals Corporation
Duette Mine
Manatee County, Florida

SOILS

RESOURCE DOCUMENT

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The Draft Environmental Impact Statement for the Estech General Chemicals (formerly Swift Agricultural Chemical) Duette Mine is enclosed for your review and comment. The document has been prepared pursuant to Section 102 (2)(c) of the National Environmental Policy Act (NEPA) (Public Law 91-190) and applicable EPA regulations at 40 CFR Part 6.9. Thirteen volumes of resource documents were also prepared. These resource documents comprise the detailed technical evaluations of the alternatives and the proposed action and contain supporting data related to the Draft EIS. While the Draft EIS is a complete document.

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SOILS

RESOURCE DOCUMENT

Draft Environmental Impact Statement

Swift Agricultural Chemicals Corporation
Duette Mine Site
Manatee County, Florida

October, 1979

Prepared for: U. S. ENVIRONMENTAL PROTECTION AGENCY
Region IV
345 Courtland Street, NE
Atlanta, Georgia 30308

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SOILS
RESOURCE DOCUMENT

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NOTE:

Effective August 1, 1979, Swift Agricultural Chemicals Corporation changed its name to Estech General Chemicals Corporation.

The preparation of the Draft Environmental Impact Statement was substantially completed at the time of the name change. Therefore, the name of Swift Agricultural Chemicals Corporation (Swift) is used throughout the Draft Environmental Impact Statement and all attendant Resource Documents.

PART I - SOILS BASELINE

1. GENERAL DESCRIPTION

Figure 1-1 provides a mapping of the surface soils that occur on the proposed Duette mine tract. A total of sixteen soil series grouped under five soil associations occur on the site. Table 1-A lists and briefly summarizes the properties of each of the soil series.

The surface soils average approximately five feet in depth and are characterized by surface horizons that are predominantly sandy in texture. Approximately eighty percent of the on-site soils are classified as poorly drained. Included in this classification are the alluvial soils associated with watercourses, the freshwater swamp soils, and the soils associated with the shallow ponds on site. The majority of the poorly drained soils , however, belong to the Leon and Immokalee series in which drainage is somewhat restricted by the occurrence of an organic hardpan at a depth of 12" to 42". The remaining twenty percent of the surface soils are well-drained due to their occurrence in slightly more upland areas and the absence of an organic hardpan (Ardaman and Associates, 1975).

The sandy texture gives the surface soils relatively high permeability (except for the hardpan layers) and low

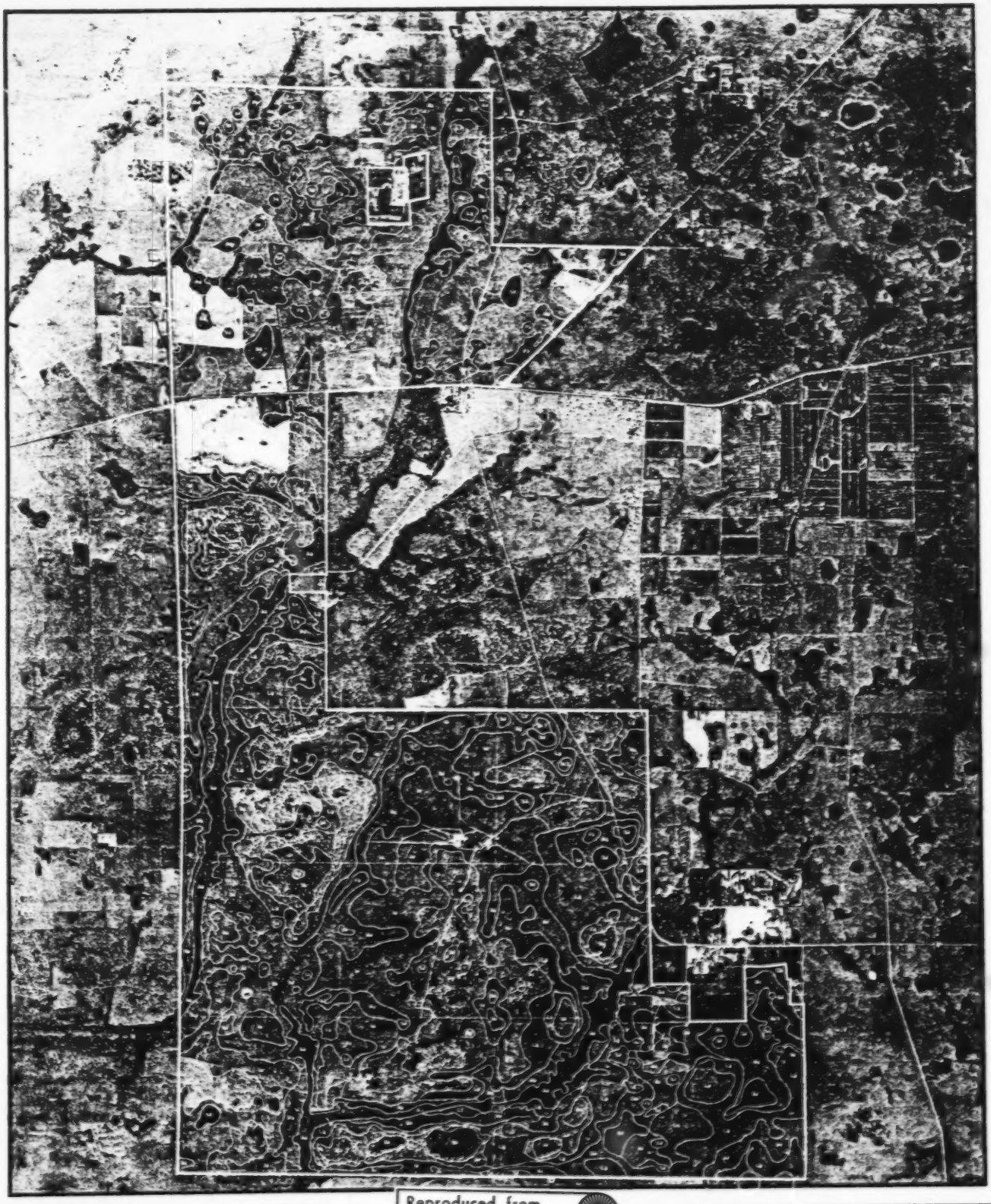

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FIGURE 1-1

SURFACE SOILS

Source: Ardaman and Associates, Inc.

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SWIFT AGRICULTURAL CHEMICALS
CORPORATION PROPOSED
DUETTE MINE
MANATEE COUNTY, FLORIDA

Table 1-A

Soil Description and Interpretation

1. Soil Association 2) Soil Series	Description (Texture, Color, Depth)	Unified Soil Classification	Permeability in./hr.	Depth to Bedrock	Depth of Wet Season Water Table	Duration of Wet Season Water Season	Slopes	Hydrologic Group	Dust Potential	Erosion Potential: Soil Erodibility Factor, k	Degree and Kind of Limitation for Low Building	Reservoir Embankment Sustainability
I. Excessively to Moderately Well Drained, Deep, Sandy Soils												
2) Pomello (Po)	Fine Sand: Light Gray-White:0-5" White:5-24"	SP,SP-SM SP,SP-SM	>20.0 >20.0	>72"	40" to 60"	4 Months	1-3%	A	Moderate	Low .003 to .02	Slight	Good, Downstream shells with Flat Slopes and Seepage Control
2) St. Lucie (Sb)	Fine Sand: Light Gray-Loose:0-5" White:5-48"	SP SP	>20.0 >20.0	>24"	>3'	4 Months	1-12%	A	Moderate	Low to Moderate .002 to .13	Slight	Good, Downstream shells with Flat Slopes and Seepage Control
II. Somewhat Excessively to Moderately Well Drained, Deep Sandy Soils												
1) Brenton (Bn)	Fine Sand: Light Gray-Loose:0-8" Brown-Weakly Cemented:8-16" Pale Yellow-Loose:16 Light Gray:16-24+"	SP-SM SP-SM SP-SM	>20.0 2.0-6.0 6.0-20.0	>40"	>2'	4 Months	0-3%	A	Low to Moderate	Low .003 to .02	Slight	Good Downstream shells with Flat Slopes and Seepage Control
2) Lakeland a)Level Phase (La)	Fine Sand: Gray:0-4" Pale Yellow:4-12" Brownish Yellow:12-42"	SP-SM SP-SM SP-SM	6.0-20.0 6.0-20.0 6.0-20.0	>55"	>3'	4 Months	0-2%	A	Low to Moderate	Low .003 to .02	Slight	Good Downstream shells with Flat Slopes and Seepage Control
b)Undulating Phase (Lc)							2-5%	A	Low to Moderate	Low .007 to .05	Slight	Good Downstream shells with Flat Slopes and Seepage Control
III. Somewhat Poorly Drained Sandy Soils												
1) Ona (On)	Fine Sand: Gray to Dark Gray:0-8" Dark Brown:8-24" Yellow Brown:24-42+"	SP-SM SP-SM SP-SM	6.0-20.0 2.0-6.0 6.0-20.0	>40"	0" to 10"	1 to 4 Months	0-3%	A/D	Low to Moderate	Low .003 to .02	Slight	Good Downstream shells with Flat Slopes and Seepage Control
2) Scranton (Sc)	Fine Sand: Dark Gray to Brown Gray:0-8" Brown Yellow:8-22" Pale Yellow:22-42"	SP-SM SP-SM SP-SM	6.0-20.0 6.0-20.0 6.0-20.0	>55"	0" to 10" 10" to 40"	1 to 2 Months 6+ Months	0-2%	A/D	Moderate	Low .003 to .03	Slight	Good Downstream shells with Flat Slopes and Seepage Control
IV. Somewhat Poorly Drained Sandy Soils with Organic Pan												
1) Immokalee (Im)	Fine Sand: Gray:0-6" Light Gray to White:6-34" Dark Brown:34-38" Brown to Yellow Brown:38-42"	SP,SP-SM SP,SP-SM SP,SP-SM SP,SP-SM	6.0-20.0 6.0-20.0 0.6-2.0 0.0-20.0	>40"	0" to 10" 10" to 40"	1 to 4 Months 6+ Months	0-2%	A/D	Low	Low .003 to .02	Slight	Good Downstream shells with Flat Slopes and Seepage Control
2) Leon (Le)	Fine Sand: Light Gray:0-4" White:4-24" Organic Pan:24-40"	SP,SP-SM SP-SM,SM SP,SP-SM	>20.0 0.6-2.0 6.0-20.0	>40"	10" to 40"	4 Months	1-3%	C	Low	Low .003 to .07	Slight	Good Downstream shells with Flat Slopes and Seepage Control
3) Leon-Immokalee a)Gently Rolling (Ly)	Fine Sand: Gray:0-6" Light Gray to White:6-30" Brown-Black Pan:30-32" Dark Brown:32-36" Light Brown:36-42"	SP,SP-SM SP,SP-SM SP,SP-SM SP-SM,SM SP,SP-SM	6.0-20.0 6.0-20.0 6.0-20.0 0.6-2.0 6.0-20.0	>40"	0" to 10" 10" to 40"	4 Months 6+ Months	0-2%	A/D	Low	Low to Moderate .003 to .07	Slight	Good Downstream shells with Flat Slopes and Seepage Control
b)Near to Level (Le)							2-5%	A/D	Low	Low to Moderate .07 to .17	Slight	Good Downstream shells with Flat Slopes and Seepage Control
4) Rutledge a)Gently Sloping (Rb)	Fine Sand: Dark Gray to Black:0-10" Gray to Light Gray:10-42"	SP-SM SP-SM	6.0-20.0 6.0-20.0	>55"	0" to 10"	4 to 9 Months	2-5%	B/D	Low	Low .007 to .05	Slight	Good Downstream shells with Flat Slopes and Seepage Control
b)Nearly Level (Rc) Phase (Rc)a							0-2%	B/D	Low	Very Low .006	Slight	Good Downstream shells with Flat Slopes and Seepage Control

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shrink-swell potentials. The high permeability, relative scarcity of silt and clay particles, and very gradual slopes combine to give the soils low erosion potential.

2. ENGINEERING

Except for the soils associated with the wetland areas, limitations for construction of low buildings are minor and relatively easily overcome. Limitations on use of the surface soils for construction of homogeneous pond embankments are considered severe. The soils can, however, be used in certain section of embankment construction provided a core of less permeable material is provided (Ardaman & Associates, 1975).

For the purposes of estimating runoff potential, the on-site soils may be grouped into the following four hydrologic groups delineated by the U. S. D. A. Soil Conservation Service (Manatee County Soil Survey, 1958).

- Hydrologic Group A - (Low runoff potential). Soils that have high infiltration rates even when thoroughly wetted and a high rate of water transmissions.

- Hydrologic Group B - (Moderately low runoff potential). Soils that have moderate infiltration

rates when thoroughly wetted and a moderate rate of water transmission.

- Hydrologic Group C - (Moderately high runoff potential). Soils that have slow infiltration rates when thoroughly wetted and a slow rate of water transmission.

- Hydrologic Group D - (High runoff potential). Soils having very slow infiltration rates when thoroughly wetted and a very slow rate of water transmission.

Dual hydrologic groups are assigned to those poorly drained soils rated under Group D provided the soils can be adequately drained. In their natural state, the poorly drained soils on site have moderately high to high runoff potentials (Development of Regional Impact, Duette Mine, 1978).

3. AGRICULTURAL PROPERTIES

The on-site soils may be broadly categorized as acid sands with low natural fertility (Zellars-Williams, Inc., 1977). The soils associated with wetland areas have somewhat higher natural fertility; however, they have generally not been developed for agriculture due to the difficulty of draining them. The excessively drained Pomello and St. Lucie soils

are generally considered too droughty for intensive agricultural use. The Leon, Immokalee, Rutlege, and Ona soils are the soils of greatest agricultural importance on the site. Though low in fertility and poorly drained in their natural state, agricultural improvements can and in some cases have been made on these soils through proper drainage, irrigation, liming and fertilization practices. The sandy texture and relatively low organic matter contents of the surface horizons give these soils low moisture and nutrient retention capacities. Consequently, relatively high levels of irrigation and fertilization inputs are required to maintain their productivity. On the other hand, the sandy texture gives the soils good tillage and aeration properties providing drainage is adequate.

PART II - SOILS IMPACT

1. IMPACT ON EXISTING SOILS

The proposed mining operation will disturb the existing soils on 7583 acres or approximately three-fourths of the site (Development of Regional Impact, Duette Mine, 1978). The following types of disturbance will be involved:

Type	Acreage
Surface Mining	6,624
Waste Disposal on Unmined Land	680
Construction of Beneficiation Plant and Ancillary Facilities	279
Total	7,583

Strip mining will totally alter the nature of the existing soils on the acreage in this category. The existing soil profiles in mining areas will be destroyed and in general the surface horizons will be buried under layers of either subsurface over-burden or waste materials. Disposal of either clay wastes or a mixture of sand and clay will effectively bury the existing surface soils on an additional 680 acres of land. Alterations in the existing soils as a result of construction of the beneficiation plant and

support facilities such as the entrance railroad, mine access roads, powerline corridors, and pipeline corridors will be less severe. The soil profiles will not be destroyed in these areas; however, it is likely that some losses in soil organic matter will occur over the twenty-year life of the mine, particularly in areas such as the parking lot and reagent storage areas which will not be vegetated during this period.

2. RECLAIMED SOILS

Waste disposal and physical reclamation techniques will result in the following three new types of surface soils on the site (Development of Regional Impact, Duette Mine, 1978):

Soil Type	Acreage
Clay	480
Sand-clay	5,426
Overburden (over sand tailings fill)	848
Total	6,754*

*The remaining 829 acres consist of 255 of reclaimed disturbed soils and 574 acres of land and lake areas, the land portions of which will be composed of over-burden material.

Figure 2-1 provides a mapping of the reclaimed soil types planned for the site. Each of the new reclaimed soil types has distinct physical, chemical, and radiological properties that relate to post-reclamation land use potential. The radiological properties of these soils are discussed in the Radiological Environment Resource Document. Their agricultural and engineering properties are discussed in the following sections.

2.1 Agricultural Properties

Clay Soil - Reclamation of the single conventional clay settling area will result in a 480-acre area with a very fine textured soil. A characterization of five phosphatic clay samples from Polk County operations identified an appreciable content of silt-sized (2-50 μ) and some sand-sized (>50 μ) particles along with the clay (<2 μ) particles (Hawkins, 1973). Mineralogically, the samples were characterized as consisting primarily of apatite, quartz, and silicate clay minerals, of which montmorillonite was dominant. This composition and particle size distribution explain the high fertility, high moisture holding and nutrient retention capacities, and poor tillage and aeration properties commonly observed for the phosphatic clay soils of reclaimed clay settling areas.

The mineralogical composition of a phosphatic clay sample

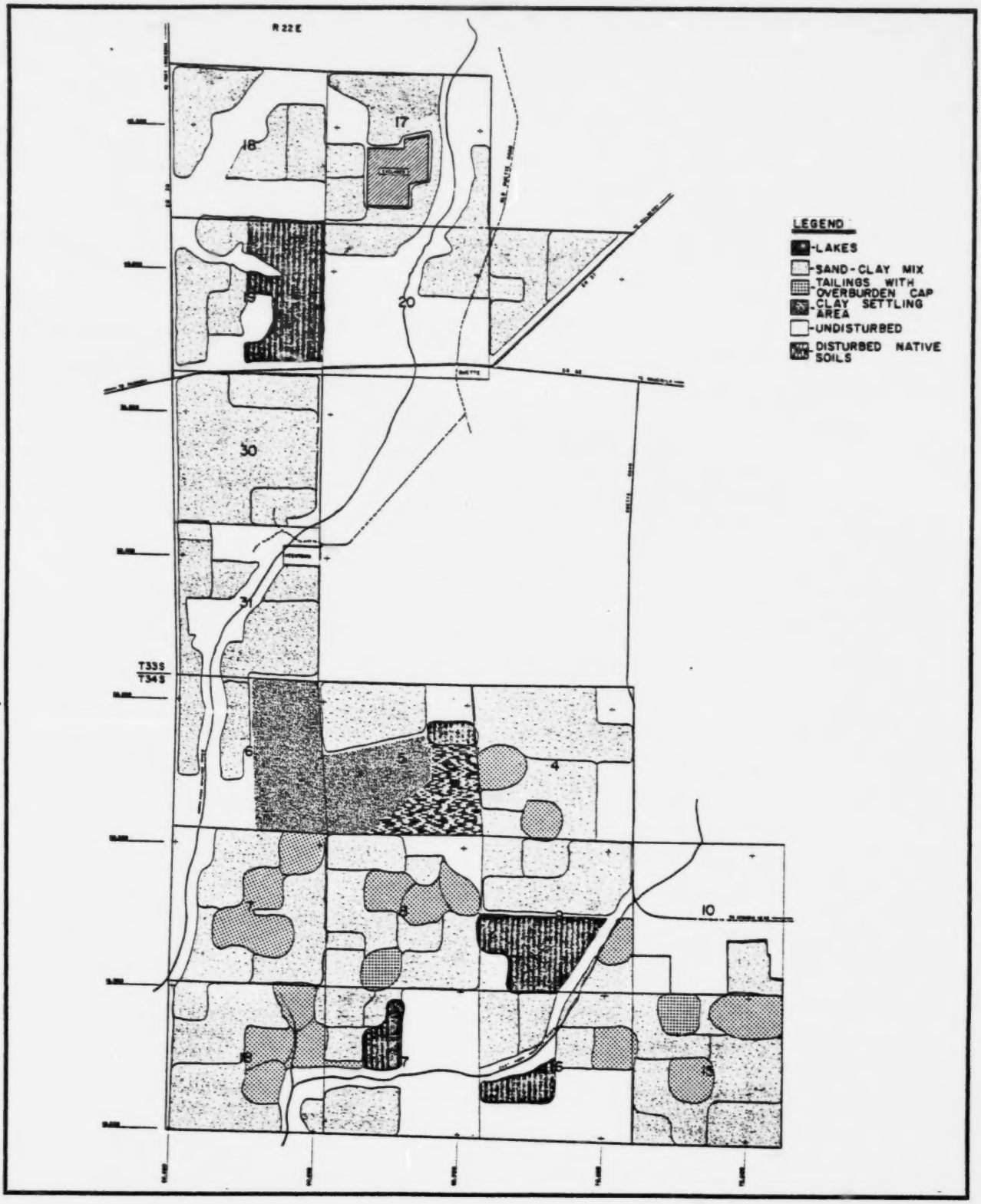

FIGURE 2-1

DISTRIBUTION OF RECLAIMED SOILS

Source: Zellars-Williams, Inc.

U.S. EPA - REGION IV
DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR SWIFT AGRICULTURAL CHEMICALS CORPORATION PROPOSED DUETTE MINE
MANATEE COUNTY, FLORIDA

obtained by beneficiating a core sample from the Duette ore zone is provided in Table 2-A (Bromwell Engineering, 1977). The Duette sample is higher in dolomite, feldspar, and quartz but lower in apatite and silicate clay minerals relative to typical Polk County clays. In fact, while the Polk County samples were found to be 50-66 percent silicate clay minerals, the Duette sample was reported to be only 25 percent silicate clay minerals. Moreover, illite rather than montmorillonite was reported to be the dominant clay mineral in the Duette ore.

Table 2-A Mineralogical Composition of Phosphatic Clay from Swift Tract

Mineral	Composition
Carbonate-Fluorapatite	18
Dolomite	36*
Quartz	18
Feldspar	3
Kaolinite	0
Montmorillonite	7
Attapulgite	7
Illite	11

*The reported content of dolomite in this sample is unusually high and may not be representative of the Duette clays as a whole.

If the Duette sample is assumed to be representative of clays occurring throughout the site, several conclusions of agricultural significance can be drawn. First of all,

montmorillonite is an expanding type clay and its predominance in the Polk deposits accounts to a large degree for the poor tillage and aeration characteristics of newly-reclaimed settling areas. The lesser influence of montmorillonite in the Duette clays can be expected to alleviate this problem to some degree. On the other hand, montmorillonite has a higher cation exchange capacity (CEC) than illite; therefore, the Duette clays will not have as high nutrient retention properties as the Polk clays.

The plant available nutrient content of the Duette clays was analyzed to provide an indication of their native fertility (Zellars-Williams, 1977). The results of this analysis are presented in Table 2-B along with analyses of native soils on the site and other materials comprising reclaimed soils. The results indicate that the native fertility of the Duette clays is high. Based on University of Florida soil test interpretation guidelines, the observed level of 170 lbs. P_2O_5 per acre is well within the adequate range for optimum plant growth, though not quite as high as available P_2O_5 levels typically reported for Polk clays, This result is reasonable in view of the somewhat lower apatite content reported for the Duette clay sample. Available K_2O is also very high and is accounted for by the feldspar and illite content of the clay. The analysis indicated very high levels of available CaO and MgO, a result that is expected in view of the reported high content of dolomite in the clay.

Table 2-B Comparison of Available Soil Nutrients

Sample	Sampling Location	Vegetation	Sampling Method	Soil Nature	pH	Nutrients - Pounds/Acre			
						CaO	MgO	P_2O_5	K_2O
1	Sec 4, T34S,R23E	Native Range	0-6"	Native	4.4	192	28	5	20
2	Sec 5, T34S, R23E	Native Range	0-6"	Native	4.1	192	26	2	10
3	Sec 6, T34S, R23E	Native Range	0-6"	Native	4.3	144	9	1	7
4	Sec 7, T34S, R23E	Native Range	0-6"	Native	4.1	144	21	2	8
5	Sec 10, T34S, R23E	Native Range	0-6"	Native	4.2	240	9	4	6
6	Sec 17, T34S, R23E	Native Range	0-6"	Native	4.2	144	1	3	10
7	Sec 20, T33S, R23E	Improved Pasture	0-6"	Native	6.7	1,488	288	9	146
8	Sec 19, T33S, R23E	Improved Pasture	0-6"	Native	5.3	888	31	5	14
9	Sec 19, T33S, R23E		Waterhole Spoil	Overburden	5.4	984	360	15	20
10	Sec 20, T33S, R22E		Waterhole Spoil	Overburden	5.4	960	264	205	24
11			Core Sampling	Phosphatic Clay	7.5	42,600	20,688	170	564
12			Core Sampling	Sand-Clay 2.5:1	7.6	15,720	8,688	235	168

In summary, the clay soil of the reclaimed settling area can be expected to have excellent natural fertility, high moisture holding capacity, and good nutrient retention properties. Due to its fine texture and to the initial absence of soil organic matter, the clay soil will have poor structure and therefore poor tillage and aeration characteristics. These factors will, however, likely be less severe than in Polk settling areas because of the lower content of clay minerals in general and montmorillonite in particular.

Sand-Clay Soil - Assuming that a homogeneous mixture of sand and clay is achieved, in the ratio of 2.5 to 1, the sand-clay soil planned for 5,426 acres of reclaimed land will fall into a sandy loam classification. Since the sand-clay mix reclamation technique planned for this project will be an innovation, there are no field examples of a comparable soil upon which to base predictions on the nature of this soil. However, soil scientists have contended for some time that a soil of excellent productivity can be formed by blending the fertility, nutrient retention, and moisture holding capacity of the clays with the excellent tillage and aeration properties of the sand tailings. Considerable experimental work dealing with phosphatic clay amendments or some of Florida's natural sand soils backs up this hypothesis. Diamond and Fiskell (1965) reported that phosphatic clay amendments of greater than 10 tons per acre significantly increased CEC, moisture retention, and retention of applied

nutrients in a sandy soil. Saxena, Hortenstine, and Mansell (1971) demonstrated improved water retention in columns of Lakeland fine sand amended with phosphatic clay.

A laboratory sample of sand-clay soil was prepared by mixing the two materials obtained by core sampling the Duette ore (Zellars-Williams, 1977). Soil test results for this sample are given in Table 2-B. Soil pH, CaO, MgO and P_2O_5 levels are well within the range considered adequate for optimum plant growth. Available K_2O is also in the high range and a need for only small amount of fertilizer potash is indicated.

The inherent fertility of sand-clay soils is good. Moreover, the silt and clay content will impart good moisture and nutrient retention properties to the soil. Initially, the soil will probably have somewhat poor structure due to the absence of soil organic matter. Tillage and aeration characteristics should, however, be significantly better than the clay alone due to the relatively high content of the sand.

Overburden Soils - Overburden soils will occur on the reclaimed site primarily as a result of the capping of sand tailings landfills. Additional overburden soils will occur on the terrestial portions of land and lake areas.

Overburden typically varies considerably in composition

depending both on natural variability and on which strata end up at the surface. Strata near the phosphate matrix frequently contain higher clay and phosphorus levels than surface strata. Since these strata typically end up at the top of spoil piles, they usually make up the bulk of reclaimed overburden surface soils. Overburden soils, therefore, tend to be fairly high in clay and phosphorus content.

In order to obtain an estimate of the native fertility of overburden occurring on the Duette tract, samples were taken from the spoil piles of two waterholes dug for cattle watering purposes on the site (Zellars-Williams, 1977). The two waterholes were dug to an approximate depth of 20 feet; therefore, the spoil should be roughly equivalent to overburden resulting from phosphate mining. Soil test results are presented in Table 2-B. Available CaO and MgO levels are adequate for optimum plant growth and suggest the presence of some dolomite in the spoil. Soil pH is borderline for both samples but in view of the adequate levels of CaO, and MgO, liming would probably not be needed. Sample 9 has a very low level of available P_2O_5 while Sample 10 has a very high available level of this nutrient, thereby suggesting that the latter sample may have originated very near the matrix. Available K_2O levels are very low and indicate the need for substantial potash fertilization.

In summary, overburden soils on the Duette tract can be expected to have fair natural fertility, moisture holding capacity, and nutrient retention properties, though not so good as the clay and sand-clay soils. Soil structure will be poor initially, but due to their relatively high content of sand, tillage and aeration properties should be fairly good. These properties can be expected to improve as soil organic matter builds up.

Conclusion - The three types of reclaimed soils described in the foregoing sections will at least be equal and in many cases superior to the disturbed native soils in terms of fertility, moisture holding capacity, and nutrient retention properties. All three will, however, initially have relatively poor soil structure due to the absence of soil organic matter. The best immediate agricultural uses of these soils will be for forage crop production where tillage requirements are less exacting. Forage plantings will serve the additional function of encouraging the development of soil crganic matter. As organic matter accumulates, more intensive cultivation will become more feasible, particularly on the sand-clay and over-burden soils.

2.2 Engineering Properties

The three reclaimed soil types will differ significantly from the native soils with respect to engineering properties. Because of the prolonged subsidence sand-clay and especially

clay soils are expected to undergo while the clay dewaters, building limitations on these soils must be considered severe. On the other hand, over-burden soils, both those overlying sand tailings fill and those occurring in land and lake areas, will generally have acceptable structural stability for building purposes. Due to their relatively high clay contents, the sand-clay and clay soils may be predicted to have moderately high to high runoff potentials. The runoff potential of overburden soils will vary from moderately low to moderately high depending on the silt and clay content of the overburden soil in question.

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